Development and Evaluation of Probabilistic Forecasts of Flash Flood Impacts

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Of all the storm-related natural hazards, flash flooding is one of the most costly and deadly in the US and globally. Weather radar has shown the potential to observe spatial patterns and intensities with flood-producing rainfall systems in real time. These radar rainfall estimates can be used to force hydrologic models, but the forecast lead time can be on the order of minutes. Contemporary stormscale numerical weather prediction (NWP) models assimilate these WSR- 88D observations to adjust model states with the aim of improving forecasts of rainfall. Typically, statistical methods are relied upon to sample the uncertainties with high-resolution NWP models to produce ensembles and to derive probabilistic quantitative precipitation forecasts (PQPFs). The utilization of stormscale ensembles combined with an ensemble of simulated basin responses to yield probabilistic flash flood forecasting (PFFF) products is well suited to be addressed in a CONUS-wide testbed format.

The proposed Intense Precipitation/Flash Flooding (IPFF) supplement to the Hazardous Weather Testbed (HWT) in Norman, OK will focus on improving forecasts of intense precipitation and the resulting potential for flash flooding using a combination of operational NWP models and experimental forecast products used at the Hydrometeorological Prediction Center (HPC) and an ensemble of contemporary stormscale NWP models that have been previously evaluated as part of the Spring Experiment. Forecast guidance will be rigorously evaluated using observed precipitation from the National Mosaic and QPE System (Q2; http://nmq.ou.edu), which is available at resolutions commensurate with the stormscale forecast products. Forecast evaluation methods will be based on tools and techniques from the Developmental Testbed Center (DTC). Secondly, precipitation forecasts (both model-based and experimental forecast products) and observations will be incorporated into a prototype system developed for CONUS-wide flash flood prediction called Flooded Locations And Simulated Hydrographs (FLASH; http://flash.ou.edu). This system will incorporate uncertainty in NWP rainfall forecasts and Q2 observations combined with hydrologic model uncertainty to arrive at PFFFs. Finally, the PFFFs will be combined with static susceptibility indices derived from GIS layers of road networks, population density, stream locations, elevation, degree of imperviousness (urbanization), land use, etc. with the goal of improving the accuracy and specificity of the flash flooding impacts. Observations of flash flooding will be ingested on a regular basis to rigorously evaluate the skill of the hydrologic forecast products.

The proposed IPFF supplement to HWT will build on the success of the existing QPF component of the Spring Experiment organized by the Hydrometeorological Testbed (HMT) and capitalize on the existing collaborations and infrastructure (i.e., data flows, computers, physical space) already in place for the HWT. The experiment will be conducted following the Spring Experiment during the warm season months of Jun-Aug when flash flooding is most prevalent. It is anticipated that results of the IPFF experiment will be transitioned to operations at HPC and the new National Water Center, improving forecasts of intense precipitation and its deadly and costly impacts. We anticipate significant improvements in forecast guidance to be used by local forecast offices for issuing flash flood warnings.